2.7 Geologic Resources

Geologic surveys and analyses of the Shadow Run Ranch TM 5223RPL[3] project site were conducted by URS Corporation. Their report, "Geotechnical Evaluations, Existing Water Storage Reservoir, Proposed Shadow Run Ranch Residential Development, Pauma Valley, North San Diego County, California," dated November 25, 2013, is included as Appendix H.

"The Update Geologic Hazards Study Shadow Run Ranch Pauma Valley, California," dated September 29, 2009, and the letter report titled, "Addendum to Geologic Hazards Study Shadow Run Ranch," dated June 4, 2012, by URS Corporation, are bound together and included as Appendix I in the technical appendices to this DEIR.

2.7.1 Existing Conditions

2.7.1.1 *Regional Geologic Setting*

The 248.26-acre site is located along State Route 76/Pala Road (SR76), about ten miles east of Interstate 15 (I15). The property occupies broad, gently-sloping terraces that slope in a southerly direction toward the San Luis Rey River, the steeper terrain in the north sloping toward Agua Tibia Mountain. The proposed development area onsite is located down slope of the mountain front. The natural drainage course of Frey Creek and several other shallow, unnamed drainages extend through the property in into the San Luis Rey River to the south. Onsite agricultural groves are interconnected by paved and unpaved access roads, with mature oak trees interspersed throughout.

Windrows of large boulders are scattered throughout the property, some of which were stockpiled during previous site-clearing and grading. Development of the fruit groves involved some grading, but general elevation differences appear small and the natural landforms appear to be relatively unchanged within most of the site.

An existing earthen water supply reservoir occupies a mesa at the foot of the hillside in the area northeast of the proposed development (see Figure 1-1, "Tentative Map"). The reservoir encompasses approximately three acres and is surrounded by orchards and oak groves. The storage capacity of the reservoir is approximately 41 acre feet. With the new spillway, the reservoir storage would be approximately 34.5 acre-feet. The reservoir is not subject to the jurisdiction of the Department of Water Resources California Division of Dam Safety because its embankment height is less than 25 feet. The reservoir stores water pumped from on-site wells and catch-basins in Frey Creek. The reservoir was constructed in the early 1960's by making a shallow, bowl-shaped cut into the mesa top and creating a low earth-fill embankment around the margins of the reservoir. A layer of bentonite along the bottom of the reservoir was put in place to improve water retention.

The site is located within the Peninsular Ranges Physiographic province, which is characterized by a series of northwesterly-oriented mountain ranges that extend from Baja California to the Transverse Ranges north of the Los Angeles Basin. Westerly-trending river systems drain the province and include the San Luis Rey River (SLRR) in the project area.

The property encompasses portions of broad alluvial fans emanating from Morgan Hill within Agua Tibia Mountain, which extends up to approximately 3,700 above mean sea level (MSL). Pala Mountain is located to the southwest of the subject property, rising to approximately 2,100 MSL. The oldest rock outcroppings in the site vicinity are crystalline basement rocks. Erosion of the high relief Agua Tibia Mountain has generated broad, coalescing alluvial fans along the margins of the San Luis Rey River Valley. The site is underlain by alluvial fan deposits that include cobble to large boulder classes of predominantly granitic rock. The alluvial fan deposits range in age from Pleistocene to Holocene age.

The tectonic setting of the San Diego region is complex and includes the remnants of an ancient subduction (the geological process in which one plate is forced below another plate) zone characterized by a volcanic arc system, regional uplift, and the subsequent formation of a broadly defined transform plate boundary along the North America and Pacific Plates. Approximately 20 million years ago, the subduction zone tectonics were replaced by transform movements along strike slip faults. These faults began to cut, slide and rotate the mountainous chain into a series of blocks. Uplift and erosion have stripped away the volcanic elements of this system, leaving only the deep magma bodies. The remnant blocks of these deep magma bodies include the Sierra Nevada, Transverse Ranges, and the Peninsular Ranges. The transform boundary tectonics still dominate the region today in the form of the San Andreas Fault System.

The regional geologic structure of southern California is dominated by right-slip faulting associated with the boundary between the Pacific and North America plates. This slip is distributed by the principal, predominately northwesterly-trending, right-slip faults across California and the continental borderland.

The most significant regional fault for the project is the Elsinore Fault zone which passes through the project site. This fault has been zoned as an active earthquake fault under the State of California Alquist-Priolo Earthquake Fault Zone Act. See Figure 2-7-1, “Setback from Fault.”

Historically, the Elsinore fault has not produced a major earthquake near Agua Tibia Mountain. An earthquake in 1885 may be the nearest large event (estimated range of magnitude is 5.8) the event is placed southeast of the project area in Pauma Valley, but none of these small events has produced local damage.

2.7.1.2 *Local Geologic Setting*

The proposed development area is underlain by a thick sequence of Quaternary alluvial fan deposits. The alluvium exposed within natural slopes, road cuts, and trenches is composed of fine to coarse sand with gravels, cobbles, and boulders. The alluvial fan deposits in the project area are estimated to be between 300 and 700 feet thick, based on available driller's logs of on-site water well.

When traced southeast toward the site, the Elsinore fault zone makes an easterly bend where Pauma Valley narrows immediately south of the site area. The fault bend produces local uplift, or upward movement. It was concluded that the project area lies within a transition from predominantly right-lateral (or horizontal) fault movement, to oblique faulting (or a combination of horizontal and vertical movement). Future fault movement in this setting could result in combinations of horizontal and vertical displacements.

The previous fault hazard investigation of the area (URS 2001) mapped a through-going 'Main Fault' that represents the main surface trace of the Elsinore fault that occurs onsite with a pronounced, westerly-facing fault scarp. Two branch faults were also discovered, the 'North Branch Fault' and the 'South Branch Fault.' This earlier study concluded that both branch faults potentially continue further north than their trench locations, possibly underlying the reservoir. Additional trenches for the current analysis discovered no faults, finding that no faults underlie the reservoir.

A suspected fault was mapped previously between the reservoir and the base of the mountain front (URS 2001). The fault was interpreted to form a break in slope at the toe of an onsite hillside and was investigated for potential hazards. The analysis concluded that the hillside topographic slope break is not related to a fault; no fault is present.

A reservoir is situated on site at an approximate elevation of 1085 feet MSL. Current capacity is 41 acre feet of water. The reservoir is situated near the base of a northwest trending ridge and is not within any stream channel or natural drainage. Runoff from the ridge is diverted via ditches from entering the reservoir. Figure 2-7-2, "Topographic Maps of Existing Reservoir," shows the reservoir on an aerial photograph with topographic lines. There are no grading plans or construction reports available for the reservoir embankments. Using historic maps and interviews, it is estimated the reservoir was constructed in the late 1950s or early 1960s. By 1964 the reservoir in its current configuration had been filled with water. It was lined with bentonite, a clay-like substance that improves water retention. Boulders were placed around the downstream margin of the reservoir probably for erosion control purposes.

2.7.2 Analysis of Project Effects and Determination as to Significance

2.7.2.1 *Guidelines for the Determination of Significance*

The *San Diego County Guidelines for Determining Significance – Geologic Hazards* (July 30, 2007) were used to assess the potential for the project to have a significant impact related to geologic hazards. The project would have a significant effect if it would:

1. Propose any building or structure to be used for human occupancy over or within 50 feet of the trace of an Alquist-Priolo faults or County Special Study Zone fault.
2. Propose any of the following uses within an AP Zone which are prohibited by the County: a) uses containing structures with a capacity of 300 people or more; b) uses with the potential to severely damage the environment or cause major loss of life; c) specific civic uses.
3. Be located within a County Near-Source Shaking Zone within Seismic Zone 4 and the project does not confirm to the UBC.
4. Have the potential to expose people or structure to substantial adverse effects because the project has potentially liquefiable soils, potentially liquefiable soils are saturated or have the potential to become saturated, or in-situ densities are not sufficiently high to preclude liquefaction.
5. Expose people or structure to substation adverse effects including risk of loss, injury or death involving landslides.
6. Be located on a geologic unit or soil that is unstable, or would become unstable as a result of the project, potentially resulting in an on- or off-site landslide
7. Lie directly below or on a known area subject to rock fall which could result in collapse of structures.

Additional geological analysis regarding the site's unique reservoir feature is provided to determine any possible effects due to seiche or overtopping.

8. Be located on expansive soil, as defined in Table 18-1-B of the uniform Building Code (1994), creating substantial risks to life or property.

2.7.2.2 *Analysis*

Guideline 1: Proposes any building or structure to be used for human occupancy over or within 50 feet of the trace of an Alquist-Priolo faults or County Special Study Zone fault.

The active Elsinore fault zone traverses the site and fault rupture is a significant hazard onsite. This fault has been categorized as an active earthquake fault under the State of California Alquist-Priolo Earthquake Fault Zone Act. If a major earthquake were to occur on the onsite portion of the Elsinore fault, the land surface along the east side of the fault could experience sudden uplift. If thrust-faulting were to occur, ground deformations would be expected. Surface faulting is likely to be constrained to locations of past fault ruptures; however, the branching fault pattern within the property suggests that future fault rupture could also branch or step within the area between nearby traces.

Trenches were dug to ascertain the presence or absence of faults in the area of the reservoir onsite. The trenches were dug into pre-Holocene alluvial fan deposits that did not appear to be displaced by a fault. Therefore the potential for fault rupture beneath the reservoir is low.

The presence of the fault-zone onsite causes Guideline 1 to be exceeded (**Impact GE-1**) and mitigation requiring appropriate 50- and 100-foot setbacks is required.

Guideline 2: Proposes any of the following uses within an AP Zone which are prohibited by the County: a) uses containing structures with a capacity of 300 people or more; b) uses with the potential to severely damage the environment or cause major loss of life; c) specific civic uses.

Guidelines 5 and 6: Expose people or structures to substantial adverse effects including risk of loss, injury or death involving landslides or be located on a geologic unit or soil that is unstable, or would become unstable as a result of the project, potentially resulting in an on- or off-site landslide.

The project proposes residential uses and continued agricultural use. The reservoir will be a component of the agricultural plan for the site and as such will continue to function and is analyzed as having the potential to cause loss of life or property.

No evidence of landslides was noted during the geomorphic analysis and air photo interpretations for the previous fault investigation (URS 2001). The current analysis concludes that minor, surface slope failures are possible during periods of significant ground shaking, but large scale landslides are not considered a significant hazard at the site given the geologic and geomorphic setting. Guideline 5 is not exceeded and impacts would be less than significant.

The stability of the existing onsite reservoir embankment was investigated for potential hazards. A fill slope bounds the reservoir to the west and south, as shown in Figure 2-7-2, “Topographic Maps of Existing Reservoir.” The embankment fill slope is approximately 25 feet in height and has downstream slopes between approximately 2.5:1 and 3:1. The fill slope toe is along the top of stockpiled boulders in some areas. Figure 2-7-3, “Cross-sections of Reservoir,” show the maximum water level relative to limits of fill.

Extensive testing of soils around the reservoir were undertaken and five borings along the top of the embankment were made. All of them penetrated fill soil, which ranges in thickness from 18.5 to 31 feet below ground surface (bgs). Beneath the embankment fill the borings penetrated weathered and decomposed granitic rock. Embankment fill was also observed and logged using test pits excavated along the crest of the embankment. Inspection of the test pits indicated the earth had been compacted at least to the depth of the pits, approximately 14.5 feet bgs. As a result the embankment can be described as a homogeneous earth dam constructed of a relatively uniform embankment fill material.

Granitic rock was found beneath the fill, as noted above. The borings penetrated the weathered rock to a depth of approximately 15 feet. Test pits were also dug 2 to 3 feet into the granitic rock.

Minor groundwater seepage was observed at the bottom of two test pits. Groundwater levels in two borings appear to be stable. No indications of groundwater seepage were observed along the slopes below the reservoir.

The slope stability was analyzed using published laboratory testing data for similar materials to those found. Computer analyses used these and other data, as well as conservative estimates about liquefaction potential and a worst case assumption as related to the nature of the ground disturbance that might occur. The analyses indicate that the earthen embankment for the reservoir will be stable for all cases tested.

The analysis further concluded that the onsite soil type, being coarse-grained and dense, is not susceptible to collapse.

Geologic conditions change over time. Changing conditions at and around the reservoir could create additional hazards. (**Impact GE-2**). As a precaution a spillway is proposed to lower the capacity of the reservoir from 41 to approximately 34.5 acre feet, a 15 percent reduction. In addition an operations and maintenance plan will be required to ensure the reservoir remains in good condition and any structural defects will be detected as soon as possible. An operations and maintenance plan will include provisions for regular inspections, criteria for inspection, and specific measures for on-going maintenance. The plan will be made a part of the Major Use Permit for the project. A copy of the plan is provided in the geologic study for the reservoir, Appendix H.

Guideline 3: Be located within a County Near-Source Shaking Zone within Seismic Zone 4 and the project does not confirm to the UBC.

The onsite presence of the Elsinore fault creates the potential for seismic ground shaking. Based on regional evaluations of probabilistic seismic shaking by the California Geological Survey, the site area has an estimated peak ground acceleration of 0.61g associated with a ten percent probability of exceeding this rate in a 50-year period.

Potential adverse impacts resulting from seismic ground shaking will be avoided by implementing appropriate building design measures which are standard in Southern California. Use of 2007 Uniform Building Code (UBC) design measures will address structural design requirements for residential buildings and other structures that will safeguard against major structural damage and loss of life. Use of the appropriate design and construction methods will allow for ground shaking hazards to be avoided. Guideline 3 is not exceeded, and impacts are less than significant. No mitigation is required.

Guideline 4: Have the potential to expose people or structure to substantial adverse effects because the project has potentially liquefiable soils, potentially liquefiable soils are saturated or have the potential to become saturated, or in-situ densities are not sufficiently high to preclude liquefaction. Seismically-induced ground settlements in loose alluvial materials have been observed during recent earthquakes (e.g., Northridge, California, and Kobe, Japan earthquakes). The analysis concluded that the presence of dry, sandy alluvial fan deposits and the potential for strong ground shaking presents a risk for seismically induced ground-settlement or failure at the site. However, the analysis also concluded that the age (tens to hundreds of thousands of years old) and anticipated density of the alluvial fan deposits, any seismically-induced settlements would be small. If settlements were to occur they would likely be limited to the upper 20 to 30 feet of alluvial soil at the site and are expected to occur relatively uniformly throughout the site. Therefore, the potential for ground settlement is negligible.

To maintain a conservative analysis of soils beneath and around the on-site reservoir, extensive testing and analysis of the reservoir construction was undertaken. This included borings, trenching, and testing of core samples from around the reservoir. The results of the analysis show that soils have been correctly compacted beneath and around the reservoir, and that the reservoir is stable. Therefore the potential for exposure of people to risk due to reservoir embankment failure is negligible. However, to ensure the reservoir embankment is well maintained, ongoing monitoring, maintenance and operational guidelines will be implemented through ongoing conditions of the Major Use Permit.

The analysis also identifies the alluvial fans underlying the site as being very coarse-grained, relatively dense, with the presence of groundwater occurring more than 300 feet below the site. Therefore, the potential for liquefaction is negligible. Guideline 4 is not exceeded, and impacts are less than significant. No mitigation is required.

Guideline 7: Lie directly below or on a known area subject to rock fall which could result in collapse of structures.

The site is underlain by alluvial fan deposits that include cobble to large boulder classes of predominantly granitic rock. The project site is not located directly below or in an area known to be subject to rock fall. Therefore, the project does not exceed Guideline 7 and impacts are less than significant. No mitigation is required.

Guideline 8: Be located on expansive soil, as defined in Table 18-1-B of the uniform Building Code (1994), creating substantial risks to life or property.

Expansive soils are those which contain significant amounts of clays that expand when wet and can cause damage to foundations if moisture collects beneath structures. Expansive soils are not present in the subsurface at the site and are not likely to exist in the alluvial fan deposits. Therefore expansive soils are not a significant hazard consideration on the project site. Guideline 8 is not exceeded, and impacts are less than significant. No mitigation is required.

2.7.3 Cumulative Impact Analysis

A cumulative study area encompassing approximately 65 square miles was analyzed for past, current, or proposed projects (see Table 1-1, "Cumulative Projects"). Oak Tree Ranch TM 5540 was studied for geological impacts, but no significant impacts were found. Significant project level impacts are mitigated with setback from fault lines. TM 5338, Campus Park, was evaluated for geological effects associated with potential fossils in geologic strata. TM 5508 (Warner Ranch) was evaluated for geologic resources related to mineral resources on the site. Projects in Southern California are required to conform to 2007 UBC requirements which address structural design requirements for residential buildings and other structures that will safeguard against major structural damage and loss of life from ground shaking. Setbacks from faults are also required. These effects, in conjunction with the project, do not constitute a challenge to a rational and comprehensive approach to geologic resources in the region because they have triggered analyses that have enhanced geologic understanding and safety in the region. Cumulative effects are not significant. .

2.7.4 Significance of Impacts Prior to Mitigation

GE-1 The Elsinore fault zone has been categorized as an active earthquake fault under the State of California Alquist-Priolo Earthquake Fault Zone Act. If a major earthquake were to occur on the onsite portion of the Elsinore fault, the land surface along the east side of the fault could experience sudden uplift. The branching fault pattern within the property suggests that future fault rupture could also branch or step within the area between nearby traces.

GE-2 Although extensive testing found the reservoir to be stable, ongoing monitoring, maintenance and operational guidelines should be implemented to ensure continued safe operation of the reservoir.

2.7.5 Mitigation

M-GE-1 Potential adverse impacts resulting from fault rupture will be avoided with the incorporation of appropriate setbacks from active faults consistent with the Alquist-Priolo Earthquake Fault Zoning Act. The proposed residential structures will be set back at least 75 feet from active fault traces located during trenching for the fault hazard investigation (URS, 2001). Setbacks of 100 feet will be applied in areas where the fault location is approximated based on air photo interpretation, geomorphology and published geologic maps. See Figure 2-7-1, “Setback from Fault.”

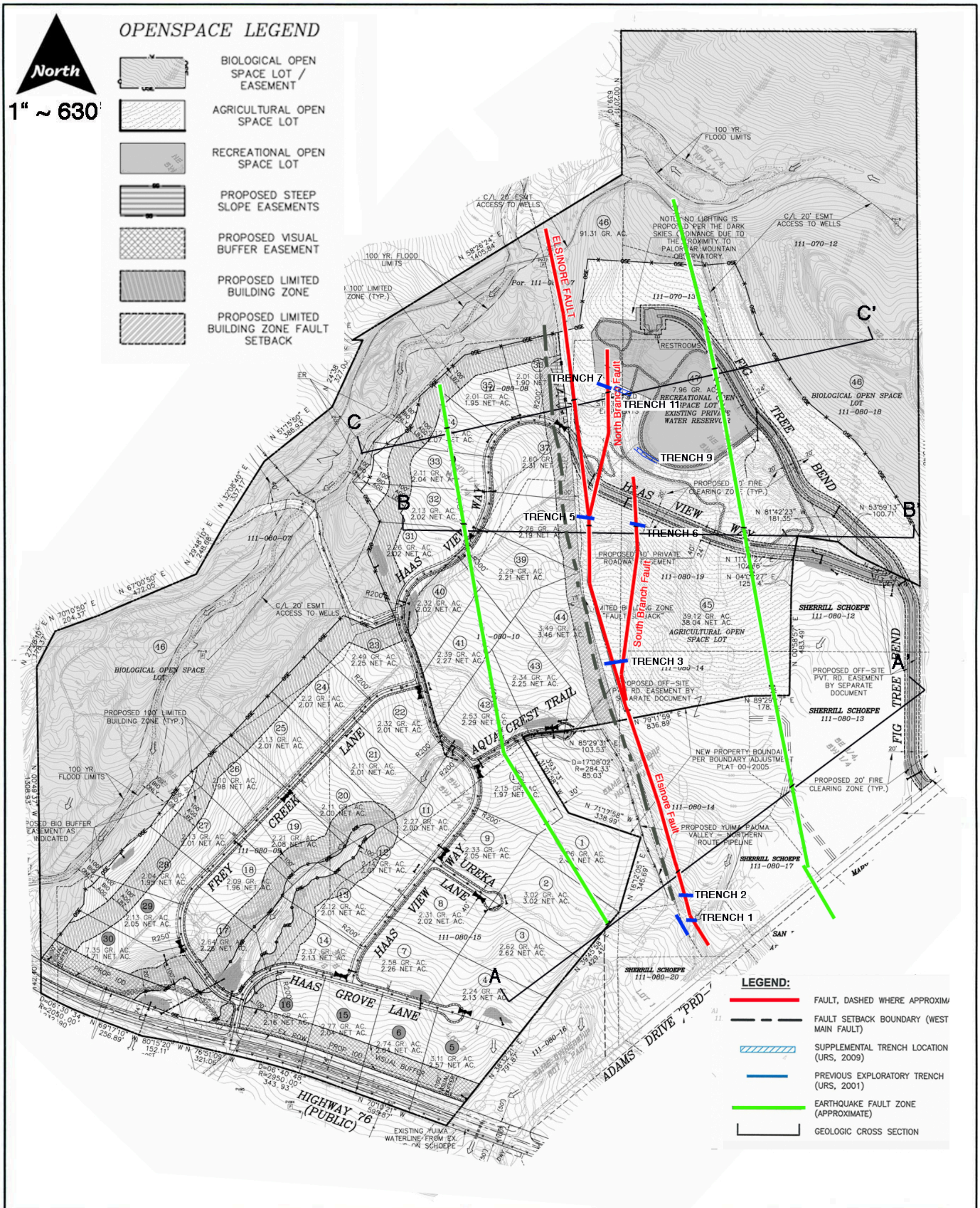
M-GE-2 The Operations and Maintenance Plan, Appendix I of the DEIR, should be implemented through the Major Use Permit for the project to require the effective operation and maintenance of the reservoir, as well as early detection and remediation of any changes in the structure, capacity, or retention characteristics of the reservoir.

2.7.6 Conclusion

The project was evaluated for geologic hazards by a certified engineering geologist and registered professional engineer. A comprehensive range of effects were evaluated which includes landslides, ground shaking, and expansive soils. It was determined that the project will not have significant effects in any of these areas due to the general stability of the alluvial substrate. The fill banks and underlying structure of the existing reservoir were tested and the reservoir was found to be stable. Seismic ground shaking is addressed by conformance with UBC structural design requirements.

Potential adverse impacts from fault rupture as the result of proximity to the Elsinore fault require the incorporation of appropriate setbacks from active faults consistent with the Alquist-Priolo Earthquake Fault Zoning Act. The proposed residential structures will be set back at least 75 feet from active fault traces located during trenching for the fault hazard investigation. Additionally, setbacks of 100 feet will be applied in areas where the fault is approximately located. These setbacks have been incorporated into the design of the Tentative Map and are shown on the Preliminary Grading Plan. An operations and maintenance plan will be implemented for the reservoir to ensure it is inspected regularly and that the reservoir is maintained.

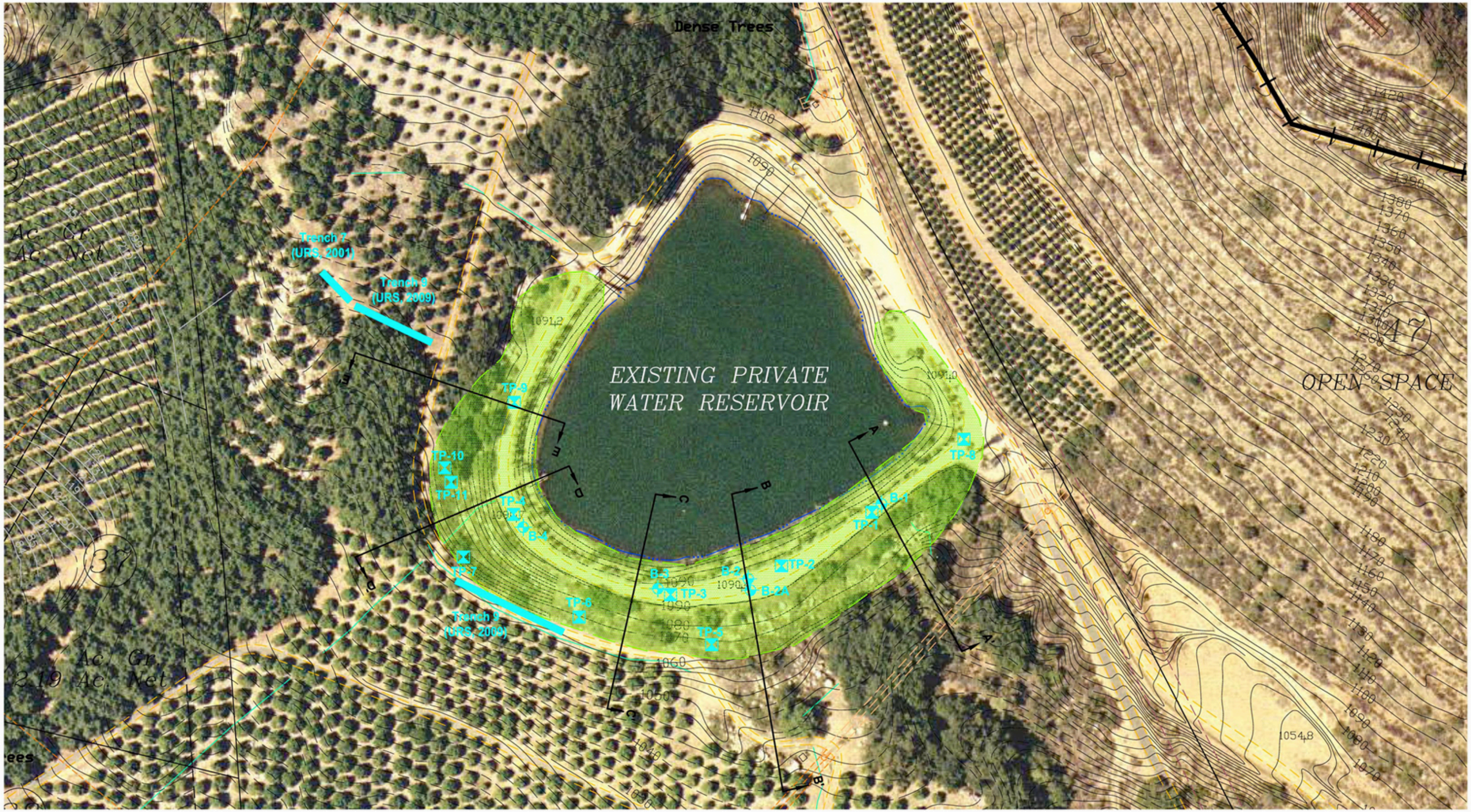
Implementation of this mitigation measure effectively mitigates impacts by preventing construction on the fault, thereby reducing risk of loss or injuring in the event of fault activity. Cumulative impacts were found to be not significant due to the lack of significant impacts among cumulative study area projects, mitigation of project effects, and conformance with regulatory safety requirements such as the UBC.



Setback From Fault

Figure 2-7-1

CONSULTANTS



LEGEND

- INDICATES APPROXIMATE LOCATION OF TEST BORING
- INDICATES APPROXIMATE LOCATION OF TEST PIT
- INDICATES APPROXIMATE LOCATION OF CROSS SECTION
- INDICATES APPROXIMATE LOCATION OF PREVIOUS TRENCH (URS, 2001, 2009)
- APPROXIMATE LIMITS OF EMBANKMENT FILL

SITE PLAN
SHADOW RUN RANCH
PAUMA VALLEY, CALIFORNIA

URS

50 0 50 100 feet
SCALE: 1"= 100'

CHECKED BY: DLS	DATE: 11-25-13	FIG. NO:
PM: DLS	PROJ. NO: 27661027.10000	3

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Figure 2-7-2

Topographic Map of Existing Reservoir

TRS CONSULTANTS

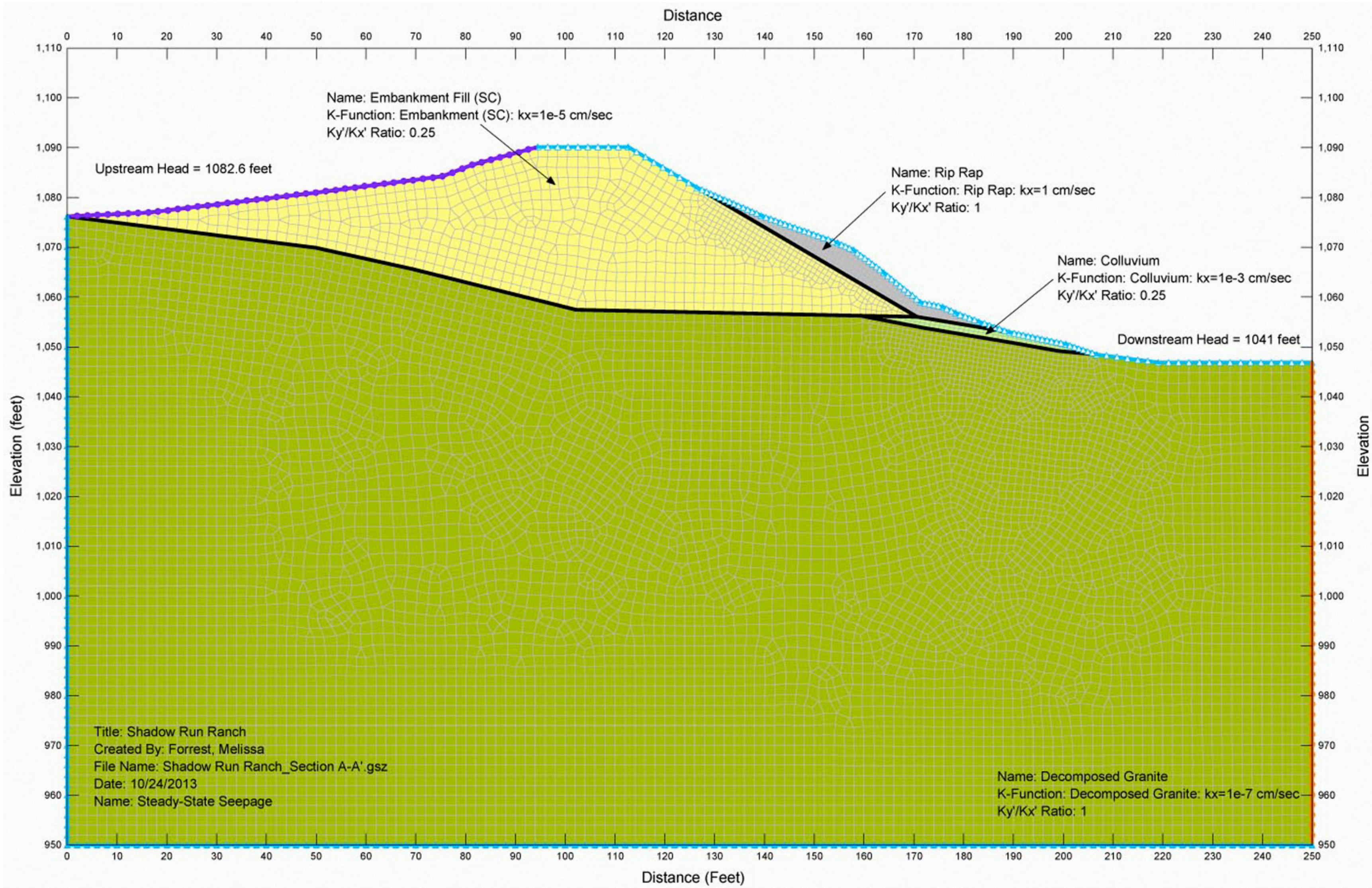

Figure 2-7-3

Cross-section A-A' of Reservoir

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